DEC. 1957
VOL. 5, NO. 4

UNIVERSITY OF CALIFORNIA
ENGINEERING LIBRARY

GENERAL TELEPHONE

TECHNICAL JOURNAL

DEVOTED TO PROGRESS IN COMMUNICATION ENGINEERING

GENERAL TELEPHONE

TECHNICAL JOURNAL

DEVOTED TO PROGRESS IN COMMUNICATION ENGINEERING

A Technical Publication of GENERAL TELEPHONE SYSTEM

WALTER AXELSEN, *Editor*

LAURENCE SMITH, *Associate Editor*

EDITORIAL ADVISORY BOARD

R. M. WOPAT — C. W. FRANK — C. F. FFOLLIOTT — I. MOLNAR

D. E. CLARK — K. W. GRAYBILL — F. L. KAHN — L. L. RUGGLES

R. STEHLIK • L. DEROISY, *Antwerp, Belgium* — D. GALASSI • C. MIGLIASSO, *Milan, Italy* — W. W. ASHWORTH • C. R. HUGHES, *Brockville, Canada*

Published by

GENERAL TELEPHONE LABORATORIES, INCORPORATED

Northlake, Illinois, U. S. A.

December, 1957 — Volume 5, No. 4

CONTENTS

Automatic Intercept Service for Telephone Exchanges
E. S. Peterson ..... Page 188

The "BD" SATT System
J. E. Ostline ..... Page 195

Novel Use of SATT Creates Unattended Toll Center
R. L. Christian ..... Page 204

ABOUT THE COVER

Our Cover Illustration was inspired by the articles on Direct Distance Dialing and the Type BD SATT system, beginning on page 195.

"OPERATION PROGRESS"

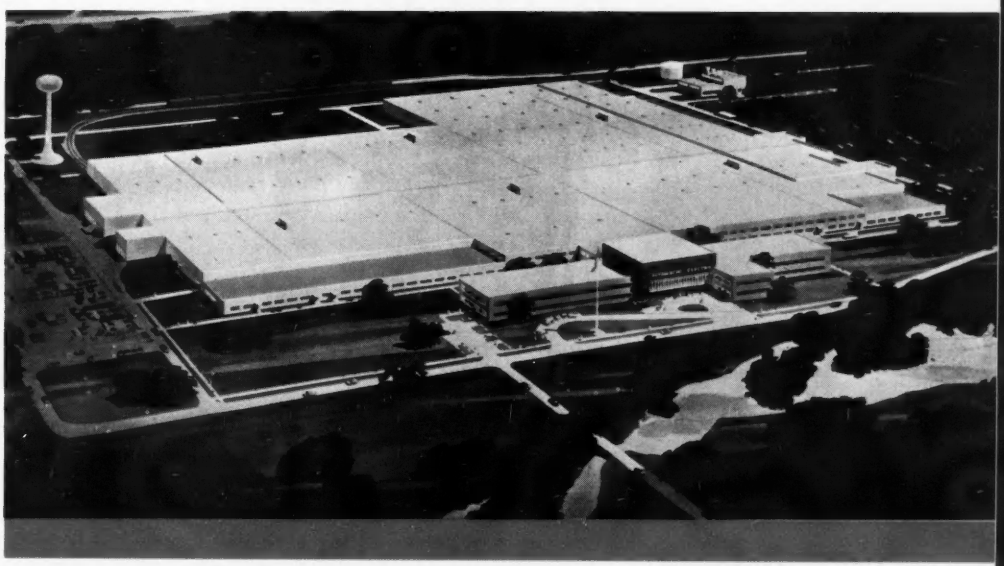
The history of the telephone is a continuous story of progress in the development and improvement of telephone exchange equipment.

In our opening article, Mr. Peterson describes two recent examples of this progress — the Type MCF and SCC Automatic Recorder Announcers. Here is an authoritative discussion on how these two units have proven practical and economical to large and small telephone exchanges for quick, dependable "interception" of calls to disconnected lines, dead levels, etc.

Succeeding articles deal with another important development in this continuous progress — a new "version" of SATT (Strowger Automatic Toll Ticketing) equipment that brings the added convenience of Direct Distance Dialing (DDD) service into small communties on a practical, economical basis, with full provision for growth that, in most communities now seems inevitable. Mr. Ostline describes this new version as a combination of the familiar Type B and D systems and tells how each type provides features as they can best be used to solve specific problems.

In planning an installation of this new "BD" equipment for Flora, Illinois, General Telephone Laboratories was presented with a new problem, resulting from the size and location of the Flora exchange. How this problem was solved is told by Mr. Christian, Systems Equipment Engineer, General Telephone Company of Illinois, in the concluding article of this issue.

These developments, and all the work of almost 200 people of General Telephone Laboratories, Inc., are closely related parts of "Operation Progress" — the project of making telephone communication increasingly convenient for growing numbers of telephone users.



AUTOMATIC *Intercept* SERVICE FOR TELEPHONE EXCHANGES

By E. S. PETERSON

Senior Project Engineer, General Telephone Laboratories, Inc.

Operator answering of intercept calls is a common practice in telephone exchanges. Calls which reach selector dead levels and disconnected subscriber's lines are automatically connected to intercepting circuits, which require answering by intercepting operators. Distant exchanges often tandem through other exchanges in order to reach the intercepting operator, with the result that trunk lines are tied up during these calls. Operator time lost in handling intercepting calls, plus the fact that in large installations considerable exchange equipment is sometimes required, makes intercept service a sizable expense.

Numerous methods have been devised to place this service on a mechanical basis. A device introduced by Automatic Electric Company some years ago, called the Type MCF (multi-channel, fixed) Recorder-Announcer (Figure 1), has proven practical and economical in large telephone exchanges, for intercept of calls with incorrect area codes or central office prefixes, and calls to vacant levels and unassigned or dead numbers.

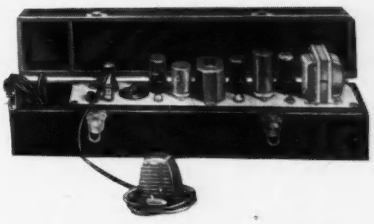
The MCF Recorder-Announcer has a maximum of five channels of fixed length (6½ or 12 seconds), with two-step erase-and-record operation, and patch-cord selection. The Announcer will give as many as five messages at once, to callers with five different problems; actually the only calls that need be referred to the operator are calls to changed numbers. It will repeat a message to 70 people at once – and since there can be a total of five messages, conceivably 350 callers could be served simultaneously.

The MCF consists basically of an 8-inch drum, carrying a rubber-base recording band (impregnated with iron oxide) for magnetic recording. The band is stretched on the outside of the drum, which is rotated by a friction drive, using a 60-cycle capacitor-induction motor, operating on 115-volt A. C.

Recordings are made by the telephone company, and may be changed as required. A recording amplifier can be mounted with the unit. Or where a telephone company has a number of the Recorder-Announcers in different exchanges, a separate recording amplifier can be provided in a carrying case, so that it can easily be moved to any exchange in which it is needed. A unit of one pick-

Copyright 1957 by General Telephone Laboratories, Incorporated

Figure 1. Type MCF (multi-channel, fixed) Recorder Announcer.



Portable "Erase and Record" Amplifier for MCF Recorder-Announcer.

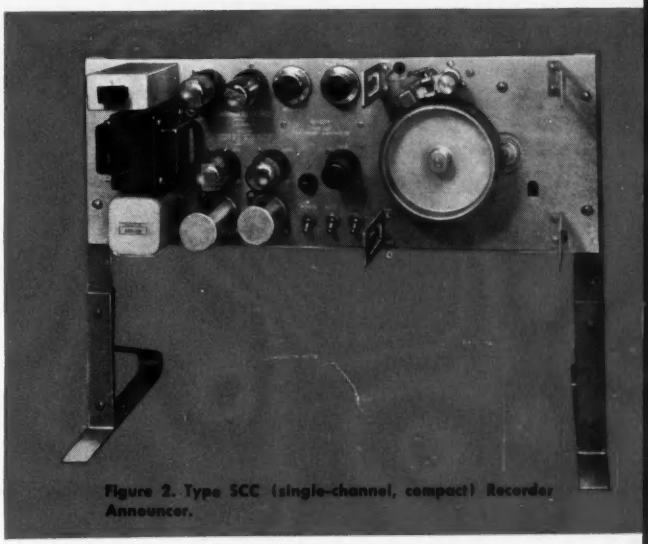


Figure 2. Type SCC (single-channel, compact) Recorder Announcer.

up head and one playback amplifier (strip-mounted) is required for each message played. The equipment is designed to mount on a standard 19-inch relay rack; adaptors are also available for mounting on different size racks.

Even though the MCF has proven its value in many large exchanges, it has been found that small exchanges could not economically use this Announcer, and did not require the five channels it provided. In order to accommodate these small exchanges, General Telephone Laboratories recently designed a less expensive *new* unit, comparable to the MCF, but providing only a single channel of fixed length (12 seconds).

The SCC Recorder-Announcer

The new Type SCC Recorder-Announcer (Figure 2), combines all the necessary components on one compact and relatively inexpensive panel. It is designed to meet every requirement where only one intercept message is needed (or, two units can be used to provide two different messages). And, like the MCF, it can be used in almost any dial exchange now using operator answering of intercept calls. Some intercept circuits will, however, require adapters such as shown in Figure 6; others will require modification of existing circuits and equipment. Intercepting circuits connect to terminals on the Recorder-Announcer marked ST, C, and MC, as shown in Figure 6.

For exchanges not now providing intercept service, a simplified form of intercepting equipment can be supplied to work with the new Recorder-Announcer. Figure 3 illustrates such an intercepting circuit for Vacant Selector Levels; four of these circuits mount on one strip. Figure 4 illustrates a circuit for Ring Cut-Off Intercepting; three circuits mount on one relay strip.

Design

The same principles of operation as used in the MCF are retained in the SCC. The drum is reduced to 4 inches, and a single playback head follows a spiral path across the drum surface, thus obtaining a 12-second record playback cycle. The combined erase-record and playback amplifier components are mounted on the front of the panel for easy maintenance. A volume control switch, a three-position control switch marked "Play", "Record" and "Erase", and Power, Play, and Busy switches are all mounted on the front of the panel for easy operation.

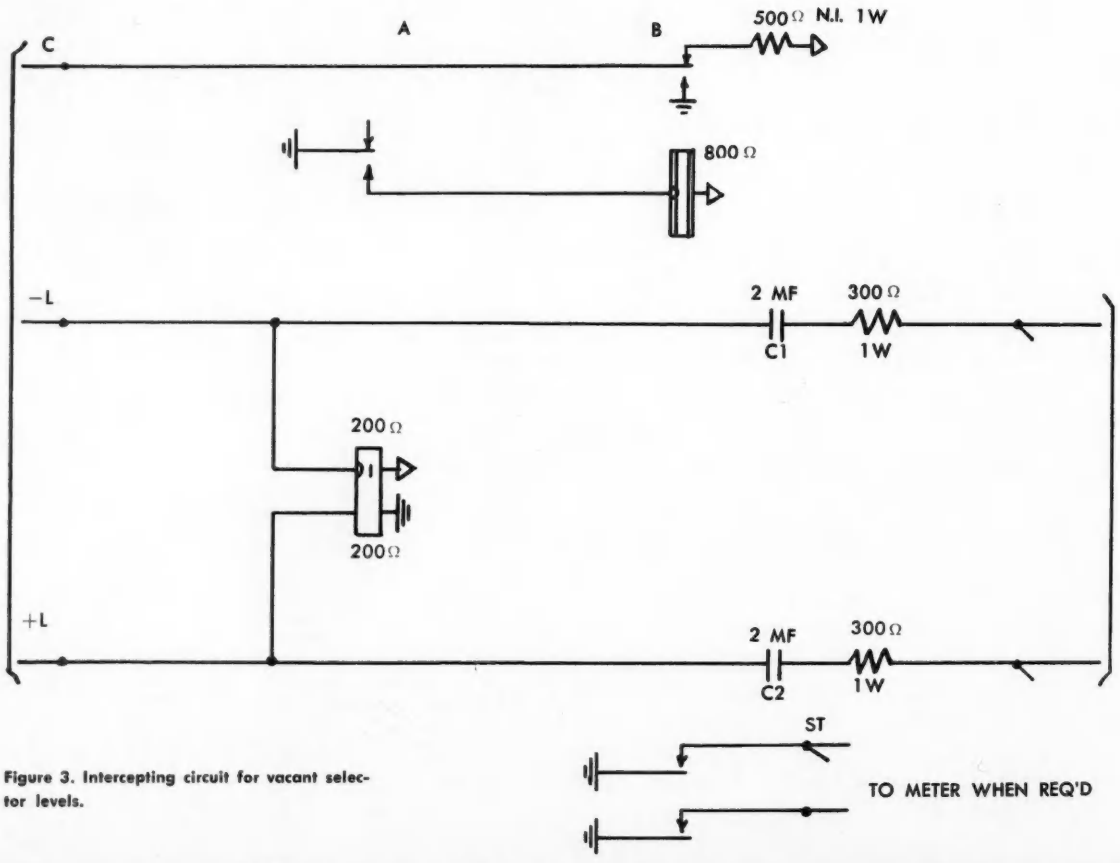


Figure 3. Intercepting circuit for vacant selector levels.

How Announcements are Recorded

A standard telephone is used to make a recording; no special microphone is required. To erase a previous message the "Busy" toggle switch is operated, preventing subscribers from seizing the machine. The turn switch is positioned on "Erase", and the "Play" switch is operated, allowing the drum to complete about three cycles to erase properly. The "Play" switch is returned to normal position, stopping the drum. The three-position switch is then turned to "Record", and the volume control switch is turned to a number setting which will provide the proper volume of recorded voice (this setting is determined by experiment). The "Play" switch is operated to start the drum, which is allowed to complete one cycle while recording is being made. After recording, the "Busy" switch is restored to normal position, and the unit is ready to be seized by an intercepted circuit.

Due to the compactness of the unit, it is possible to move it to a quiet location for recording. However, since the recording telephone can be connected to the unit by a pair of ordinary, unshielded wires, it is usually easier to move the telephone to a quiet place and make the recording with the assistance of an operator at the unit. A signal lamp is provided so that the operator can signal the recording party when to start and stop recording.

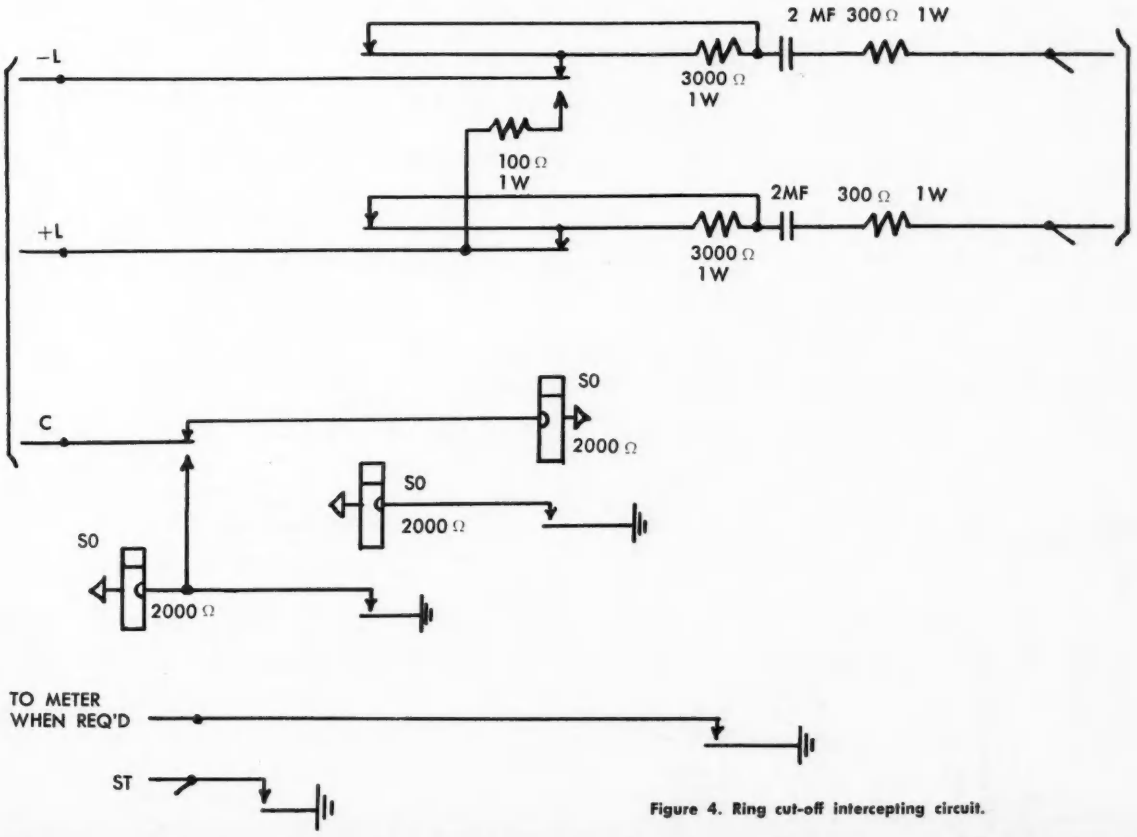


Figure 4. Ring cut-off intercepting circuit.

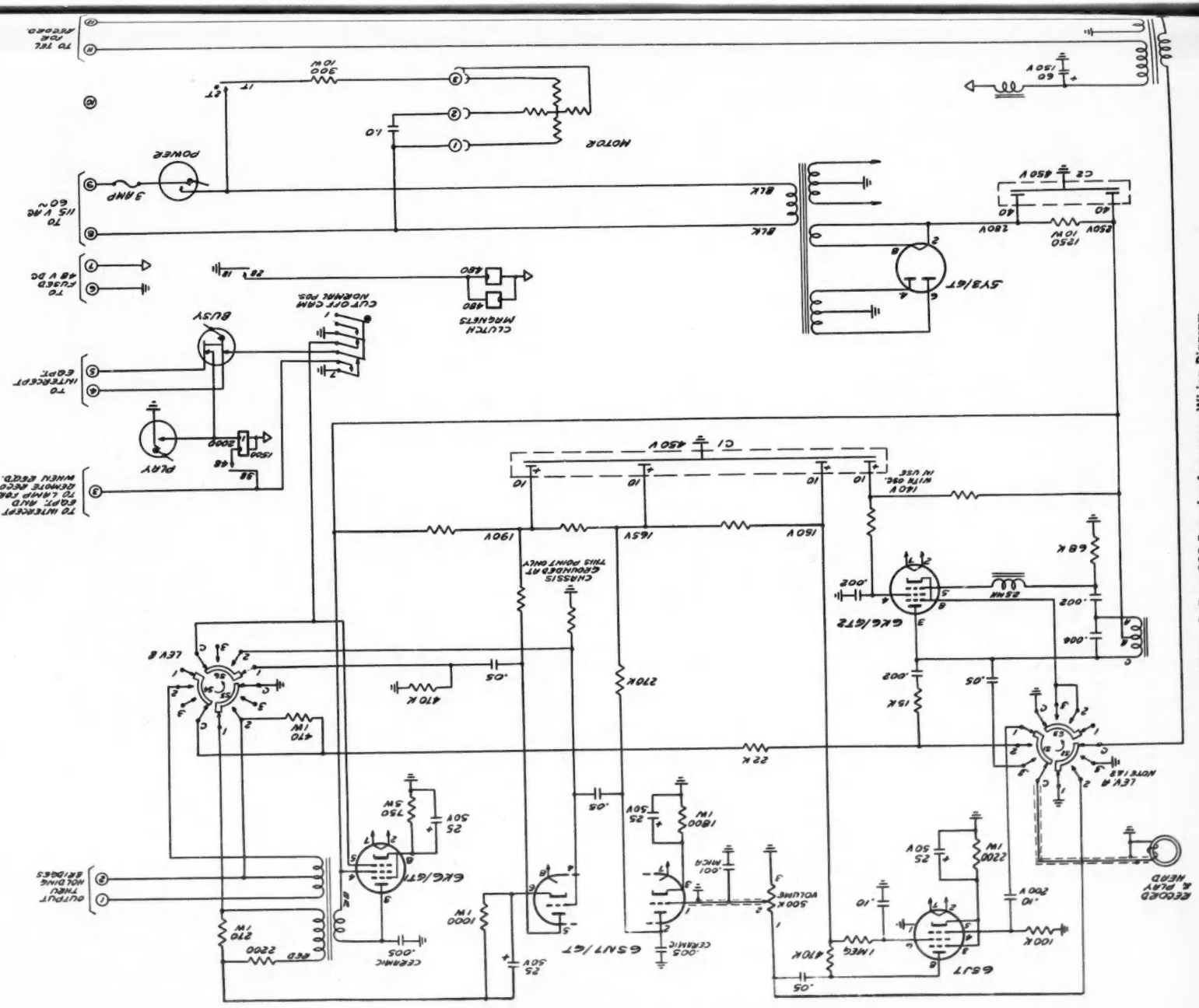


Figure 5. Type SCC Recorder Announcer Wiring Diagram.

Call Intercepting Operation

When a call is intercepted through the Adapter Circuit (for example Figure 6), ground over the L lead is closed to the MA relay. This in turn closes the No. 1 winding of the start relay (Figure 5) which is connected to the MA relay through lead No. 5.

The No. 1 winding of relay MC (Figure 6) is closed from the ground at the cam springs over the No. 4 lead (Figure 5). The start relay also closes the clutch magnet which brings the motor shaft into contact with the drum of the SCC Recorder Announcer. The drum rotates when the motor circuit is closed by operation of the start relay. The clutch magnet lifts the shaft from the drum when it is not being driven.

As soon as the drum begins to turn, the cam springs are released; this action closes a ground over the No. 3 lead to the No. 2 winding of the start relay, thus causing it to remain operated during one cycle of the drum.

During transfer of the cam springs ground is closed to the C lead (Figure 6) before ground is removed from the MC lead; thus relay MC remains operated on its No. 2 winding. The S lead is grounded by relay MC, which in turn, through intercepting equipment (not shown), removes ground from the L lead.

Relay MC then closes the recorded voice circuit to the calling party; at the end of this operation, the start relay and clutch magnet are restored, stopping the drum.

During the above circuit operation, the record-playback head is spiralled across the surface of the drum by a cam to give a 12-second announcement. At the end of each cycle, the spring roller riding on the edge of the cam operates to close the spring contacts, which short the circuit to the grid of the output tube, thus preventing the head from picking up sound during its return across the drum surface at the end of each cycle.

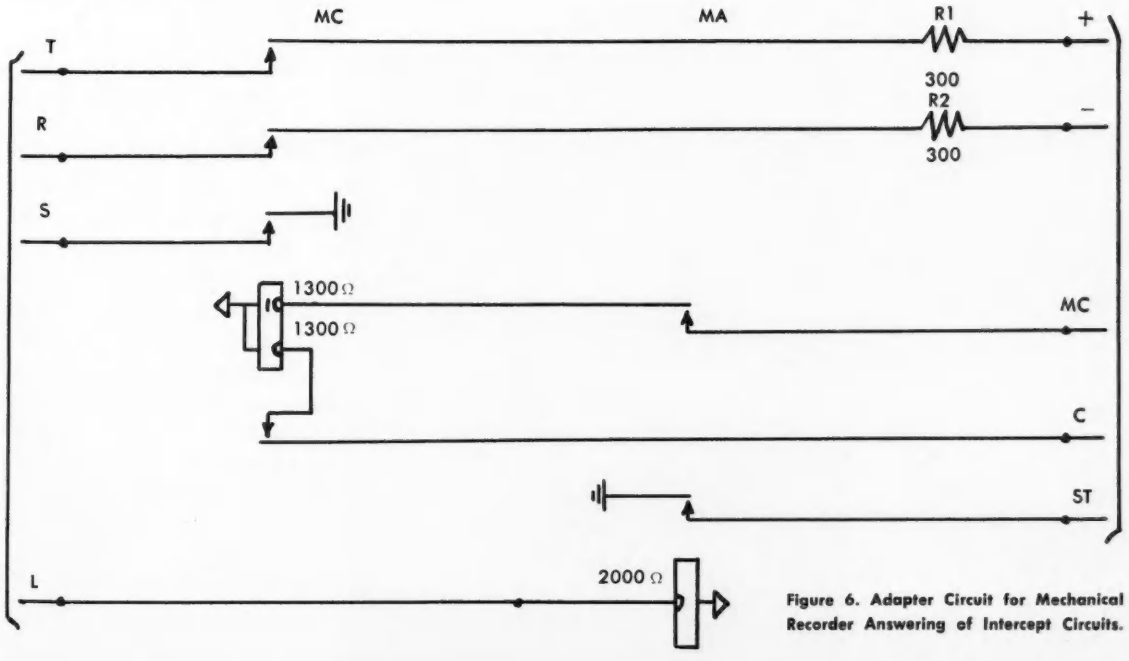


Figure 6. Adapter Circuit for Mechanical Recorder Answering of Intercept Circuits.

Installation

The components of the SCC Recorder-Announcer are mounted on a panel 7 inches high and 19 inches long. This panel will mount on standard electronic equipment racks, or on Western Electric 19-inch racks. All connections are made to the terminal block—except that a standard cord and plug are provided for connection to the A.C. supply.

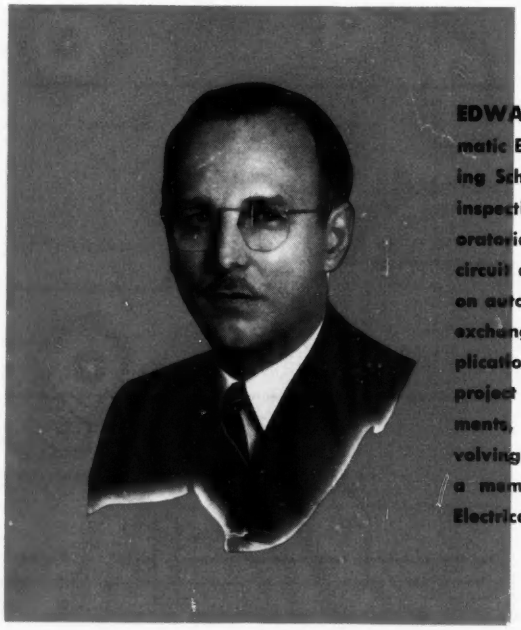
Maintenance

The SCC unit requires very little service. The amplifier, a simple audio amplifier, requires only tube replacement, which can be made from the front of the panel. Motor bearings have oil cups which require oil every three months. Lubrication of the surface of the sound track is required every 30 days for smooth recording, and to prevent wear; a special lubricant is provided for this purpose. A dust cover (not shown in Figure 2) encloses the drum at all times, to prevent dust from accumulating on the drum band.

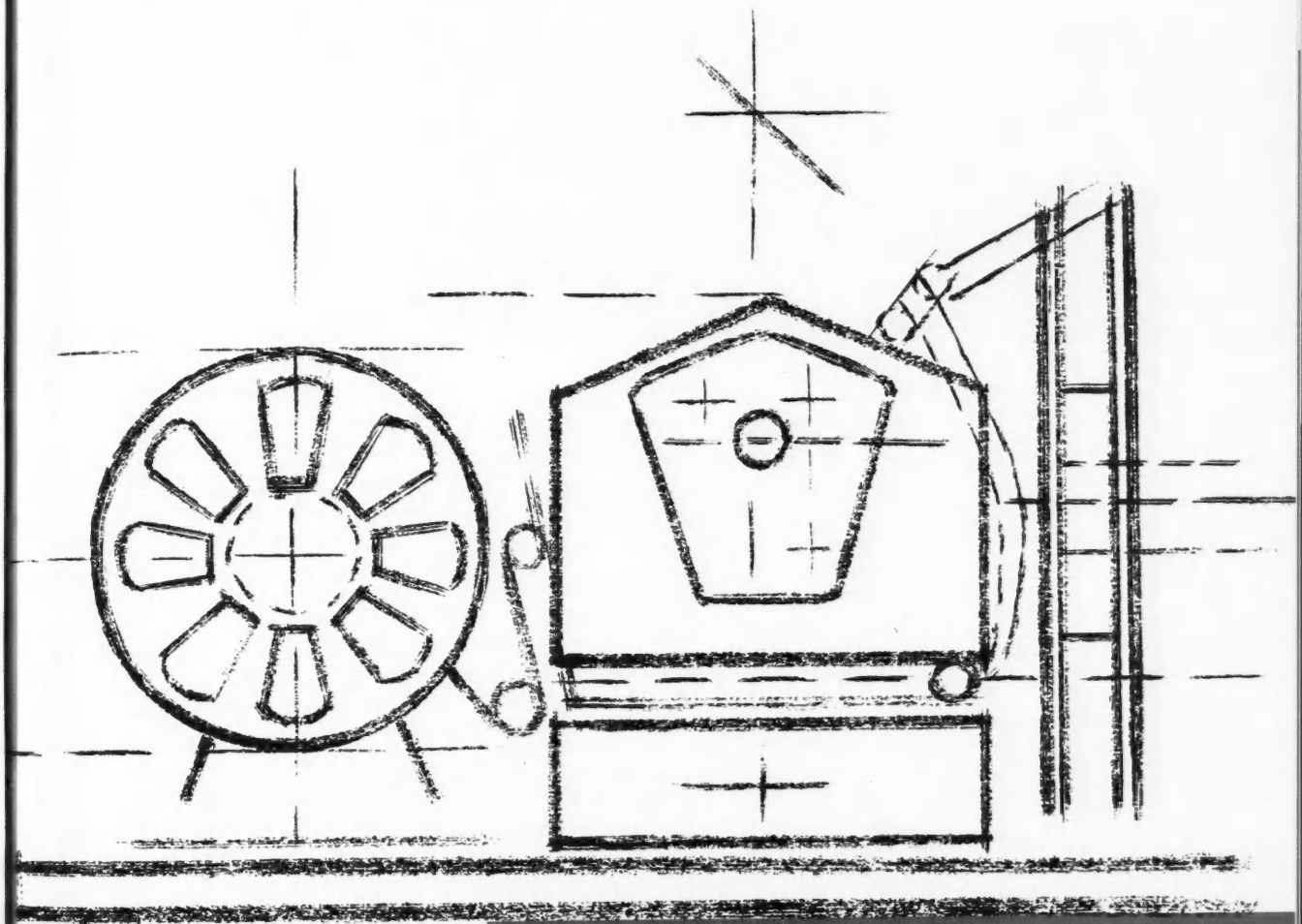
Conclusion

The Type MCF Automatic Recorder-Announcer has proven to be the most appropriate "mechanical" unit for large telephone exchanges, because it provides repetitive service for intercepting calls (as many as five messages at once). It has led to the present trend in large exchanges to consider mechanical interception as a "standard" method of easing operators' burdens, and has reduced the need for intercepting equipment in large installations of this kind.

The recent development of the smaller unit, Type SCC Recorder-Announcer, has provided small exchanges (where only one channel is required) with the same mechanical intercept service, on an inexpensive basis. Thus, Automatic Electric provides Automatic Recorder-Announcer service which speeds up the handling of intercept calls—which in turn increases the efficiency of subscriber's service, and the net return on investment in exchange equipment.



EDWARD S. PETERSON came to Automatic Electric in 1920, attended the Training School, and, after a few years in the inspection department, entered the Laboratories as a technician. He joined the circuit design section in 1927 and worked on automatic exchanges, remote controlled exchanges, and other special circuit applications. Since 1940 he has been a project engineer on industrial developments, specializing on applications involving electronic devices. Mr. Peterson is a member of the American Institute of Electrical Engineers.



INTRODUCING
THE "BD"
SATT SYSTEM

THE "BD" SATT SYSTEM

By J. E. OSTLINE

Project Engineer, General Telephone Laboratories, Inc.

Before discussing the "BD" SATT system and the job it can do, let us recall the four basic types of SATT systems:

Type A is a Director-controlled system, primarily for use in metropolitan areas. To make a short-haul toll call, the subscriber dials only the directory number of the called station. His call is automatically directed over the preferred route or an alternate route; the directory number of the calling station, whether individual or party-line, is automatically detected (identified) and recorded by the ticketing equipment.

Type B differs from Type A in that a calling subscriber must dial a SATT access code before dialing a called number. As with Type A, the number of the calling line or calling station is automatically detected and recorded.

Type C also requires a calling subscriber to dial a SATT access code, but in addition, he must also dial *his own* telephone number, immediately before dialing the called station number. Automatic verification of the calling line number is provided.

Type D requires a calling subscriber to dial only a SATT access code and the number of a called station. Before completion of the call, an operator is connected to the line; she asks for the number of the calling station, and then key-records that number into the ticketing equipment. The talking path to the called station is then automatically completed.

From the foregoing capsule descriptions, it is evident that the basic difference between Type B and Type D systems resides in the methods of obtaining the number of the calling party when he dials a station-to-station toll call. In the Type B system this function is entirely automatic, while in the Type D it is manual. In the BD system, as the name suggests, both methods are used (only one on each call, of course!) to provide a combination of service and economy.

The equipment needed to automatically obtain a calling station number in a Type B SATT system exchange includes a "detector", which is common to all lines in an exchange, and a "party identity" ("spotter") dial, on each *party-line* station instrument. In the Type D system this equipment is not required; however, manual D positions, answering equipment, and trunks between the manual positions and the D SATT equipment, must be provided; day and night operators must also be available.

Manual recording of calling station numbers in the D system results in lower equipment cost in any given exchange. Of course, the higher operator costs in a D system, as compared to a B system, must also be considered, but in many cases (except for rush-hour periods) regular "DSA" or toll operators can generally handle D SATT service traffic in addition to regular traffic.

Subscriber dialing is identical in both Types B and D systems. The customer dials an "access" code, followed by the digits required to obtain a called station number. There are no special digits to be dialed to identify the calling station, or to establish trunking paths or alternate routings. All routing and "re-dialing" of a customer-dialed toll call is completed automatically by the "transender", a common component in the "BD" SATT system.

Savings With "BD" Operation

The first Type "BD" SATT system was introduced in an area in which it had initially been intended to provide Direct Distance Dialing service among a number of exchanges on a Type B system basis, with all ticketers to be located in a centrally located office. However, traffic studies indicated that the amount of station-to-station toll calls from smaller tributary offices in the network would not justify Type B operation on such calls. Basically, this was due to the necessity of providing a detector and B trunk equipment for each tributary office—also station identity (spotter) dials at all party-line stations. This would have made the initial cost of these offices much higher than if they could be operated on a Type D system basis.

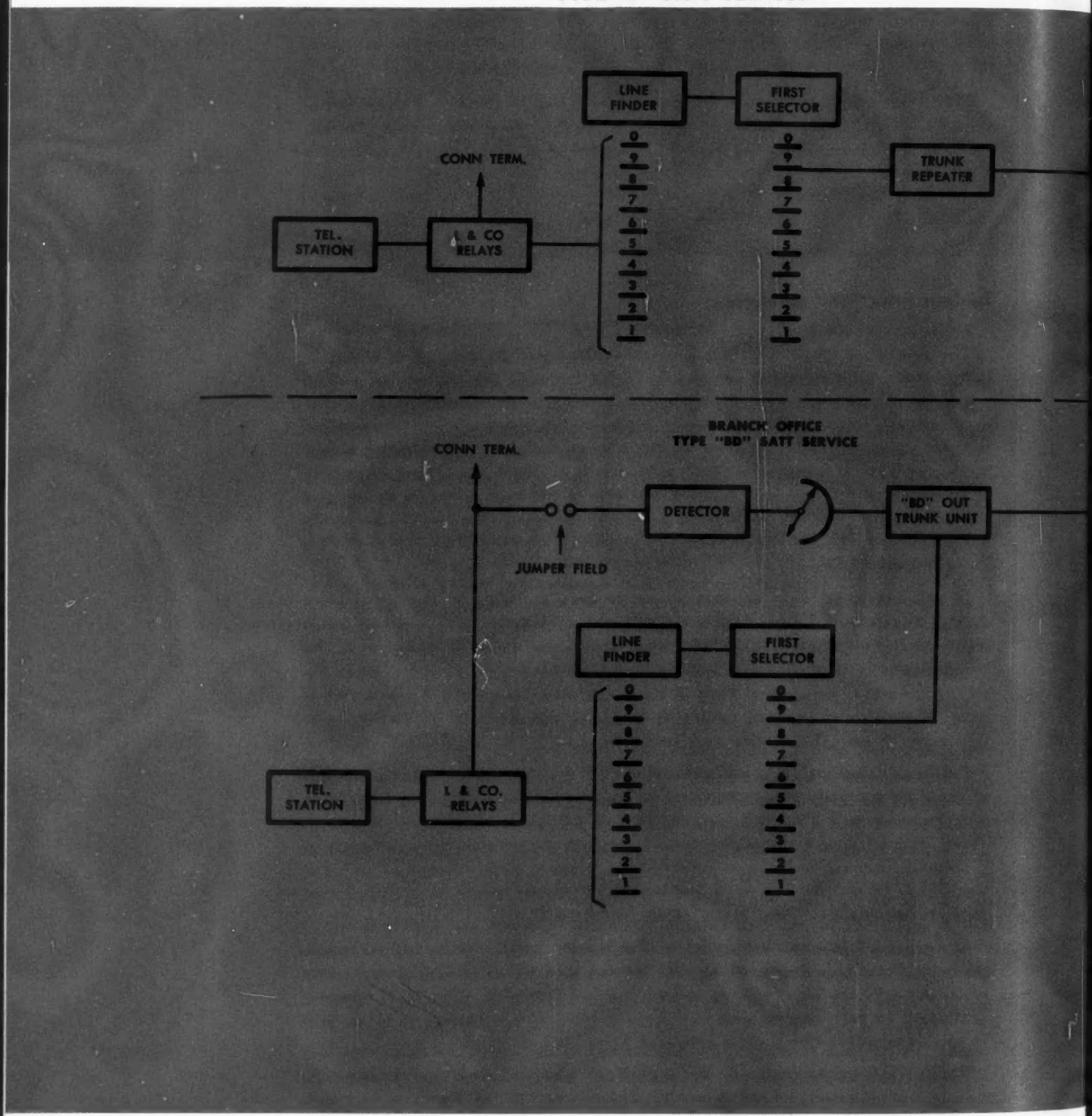
In this particular case, manual operators were available in the main office (which was the toll center of the network). It was therefore proposed to provide DDD service for these smaller offices on a straight Type D basis (with the Type D ticketers and operators located in the toll center office), and to serve the toll center office, only, on a Type B basis. However, since the Type B and D ticketers are similar in many functions, a ticketer was designed which combined the Type B and D facilities and functions, called the Type "BD" ticketer.

Continued study of this initial "BD" SATT installation disclosed a method of similarly reducing equipment costs in offices which were arranged to provide SATT service on a Type B basis only. In such a Type B exchange, all terminals (both individual and party-line) would normally be permanently connected to a detector, for automatic number-detection when a station-to-station toll call was dialed. In addition, all party-line station telephones would be equipped with station-identity dials. (See "Main" office in Figure 1).

Since party-line subscribers initiate a relatively small portion of station-to-station toll calls, it appeared logical, for the purpose of reducing equipment costs, to apply the same type of calling number detection (that is, D operator challenge) to *party-line* stations in a Type B office, as was applied to *all* stations in small exchanges which are a part of a Type "BD" network.

This could be done simply by providing "jumper" facilities between the terminal equipment and the detector, as shown at "X" in Figure 1. All calls from individual-line stations would continue to have their numbers detected and recorded automatically via the detector, but the "Main" office "BD" ticketer

BRANCH OFFICE
TYPE" D" SATT SERVICE



MAIN OFFICE
TYPE "BD" SATT SERVICE

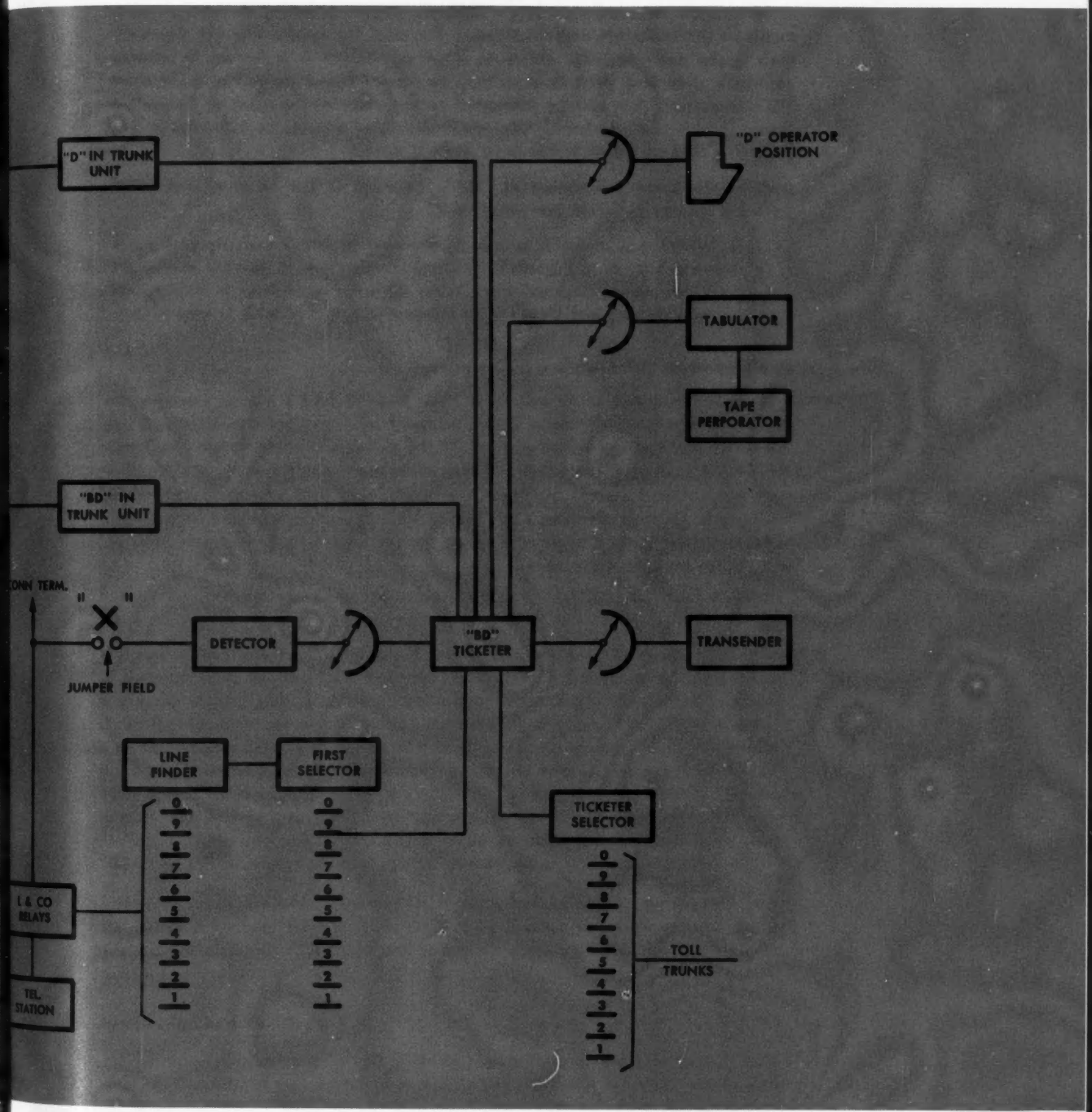


Figure 1. Block diagram of type "BD" SATT system network with mixed "BD" service in Main office and branch office and straight "D" service in branch office.

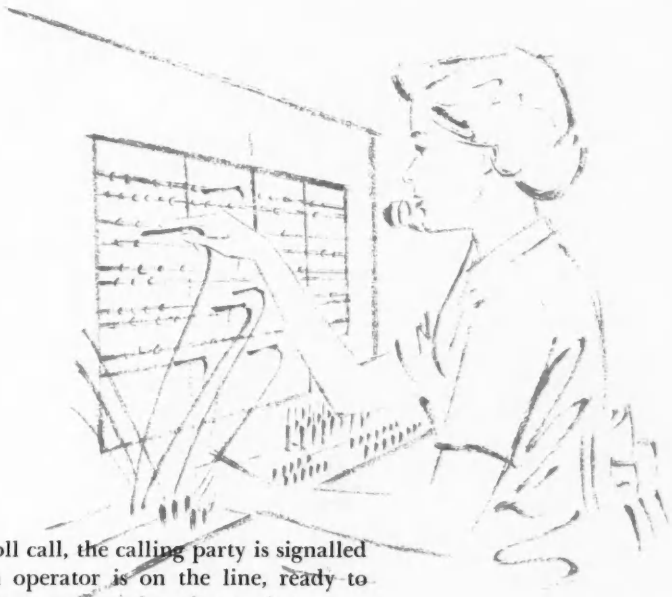
would be arranged to extend all *party-line* calls originating in that office, to a D operator for calling-number registration. With this arrangement, only individual lines are connected to the detector, thereby reducing detector requirements in the exchange, and eliminating the need for special identity (spotter) dials at the party stations. However, if for any reason it is desired to provide automatic detection (that is, B service) to some selected party lines in a Type "BD" exchange, they can be connected to the detector the same as individual lines. In this case, station-identity dials would, of course, be provided at the party-line stations which are to have Type B service.

From the above description of "BD" operation it can be seen that "BD" service is applicable under two conditions:

(1) Where it is desirable to use B operation in larger exchanges of a network, but more economical to use D operation in smaller exchanges.
(2) Where only individual lines in an exchange need have B service, and some or all party lines can be economically served with D operation.

Application to "D" Area in a DDD Network

A station-to-station DDD call in a Type B or D SATT system requires the dialing of a prescribed "access code", followed by the called-area code and the station number of the called station. If the called station is within the home numbering plan area, the access and area codes are not required—only the called station number is dialed. Numbers are 7-digit ("2-5")—a basic requirement in nationwide DDD operation. The "BD" SATT system is arranged to establish connections to stations with seven-digit numbers, and to handle toll calls to other areas on a ten-digit basis.



When dialing is completed on a D system toll call, the calling party is signalled by a "zip-zip" tone, which indicates that an operator is on the line, ready to record the calling station number. Operating experience has shown that many subscribers in a system of this type give the station numbers immediately after hearing the "zip-zip" tone, without waiting for a request from the operator. If not, the operator will enter the connection and ask, "What is *your* number, please?"

D operator trunks normally are terminated in regular D positions located in the same office as the SATT Equipment. When a trunk is seized, the operator receives a signal, and picks up the trunk by operating a key. After verbally obtaining the number of the calling station, the operator "keys" the number into the ticketer associated with the call. If a keying error is made, a "correction" key is immediately operated, after which the number is again "keyed in." This operation is completed by the keying-in of the last digit (or a "sender-release" key may be provided); this releases the operator trunk and starts completion of the connection. (If the D operator trunks are terminated in existing "DSA" or toll manual positions, operation may differ slightly from this.)

Equipment is available whereby D operator trunks can be terminated in a manual office remote from a D or "BD" SATT office in which manual facilities are not available. This equipment and its application, is described in the concluding article in this issue.

Application in a "B" Area

Now let us consider that a call is being placed from a customer in a B area. (We must point out that all telephones on party lines in a B system area have a special SATT dial, which provides automatic identification of the calling party's number so that it can be recorded by the ticketer.)

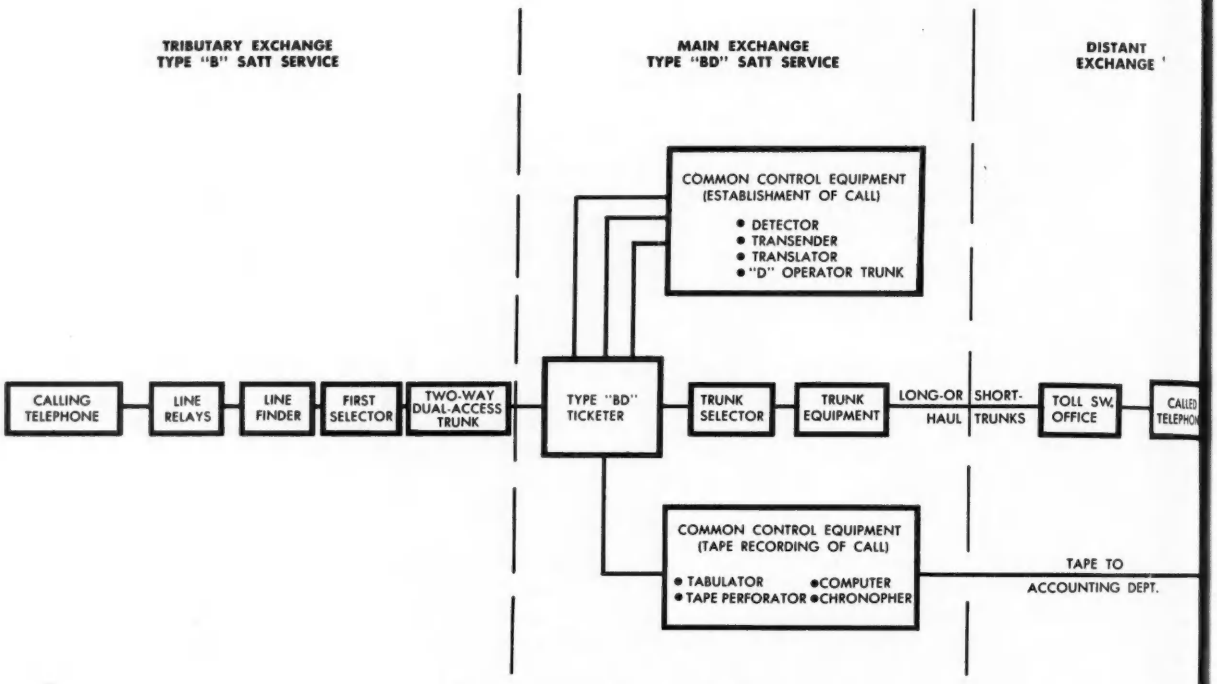


Figure 2. Units used for the talking path.

When the handset is lifted, the line equipment associated with the customer's line operates in conjunction with a linefinder switch, which in turn is associated with the first selector. The customer now receives the dial tone to proceed with the call.

If the call is to a distant area, the first digit of the access code (assumed to be "90") is dialed and this engages a ticketer. The next digit dialed is "0". This brings into play the SATT dial to transmit the impulses that identify the calling station (if it is on a party line). At this time the detector is also associated momentarily with the call to complete the job of calling-station number identification. The calling number is stored on memory units in the ticketer; at the same time a transender, for further processing of the call, is associated with the ticketer.

The next digits dialed are the area code. These numbers are stored in the transender for establishing the connection, and in the ticketer for the call record.

After the three digits of the area code have been dialed and stored in the transender, the next piece of equipment to be used is the translator. The translator is associated with the transender only momentarily, and the transender is associated with the call while a connection is being established. The ticketers is, however, associated with a toll call from beginning to end. Therefore, there are a greater number of ticketers than other components in a SATT system.

The transender transmits the call over the required route by transmitting pulses which are produced from the information received by the transender from

the translator. This group of routing pulses is termed a "directive", and may consist of from two to ten digits. The trunk selector, being associated directly with the ticketer, selects the proper trunk group to route the call.

When the called station answers, the ticketer will receive an answer supervision signal, which starts the timing of the call. During the call the following units are in use for the talking path: calling telephone, linefinder, first selector, ticketer, trunk selector, one- or two-way toll trunks, distant toll office equipment, distant local office equipment, and called station telephone (see Figure 2).

When the calling party hangs up, all the trunks and abovementioned units, except the ticketer, are released. The ticketer is extended to a tabulator, which receives from the ticketer the area code, called and calling numbers, conversation time in minutes, and the number of the ticketer; after this, the ticketer is released.

The tabulator now has the basic data on a completed toll call. With this information, it calls upon a computer (if provided) which takes the number of minutes of the call, and the rate, and then automatically calculates the charge for the call and transmits this information back to the tabulator.

The tabulator now sends to its associated perforator all of the ticket data—i.e., the seven digits of the calling number, the area code and the seven digits of the called number, the date, the clock time, and the charge for the call—all of which is recorded by means of perforations in the tape. The date and the clock time are provided by the chronopher—a unit, common to the entire system, which provides date, clock time, and day and night rate data to all tabulators in a SATT exchange. The SATT equipment has now completed its job of receiving, routing and recording a customer-dialed toll call.

Calls which, for any reason, are not completed, do not require record storage of any type, and since nothing is recorded until a call is completed, such calls do not produce partial records which would have to be processed with completed calls. Peg counts of uncompleted calls are provided.

Conclusion

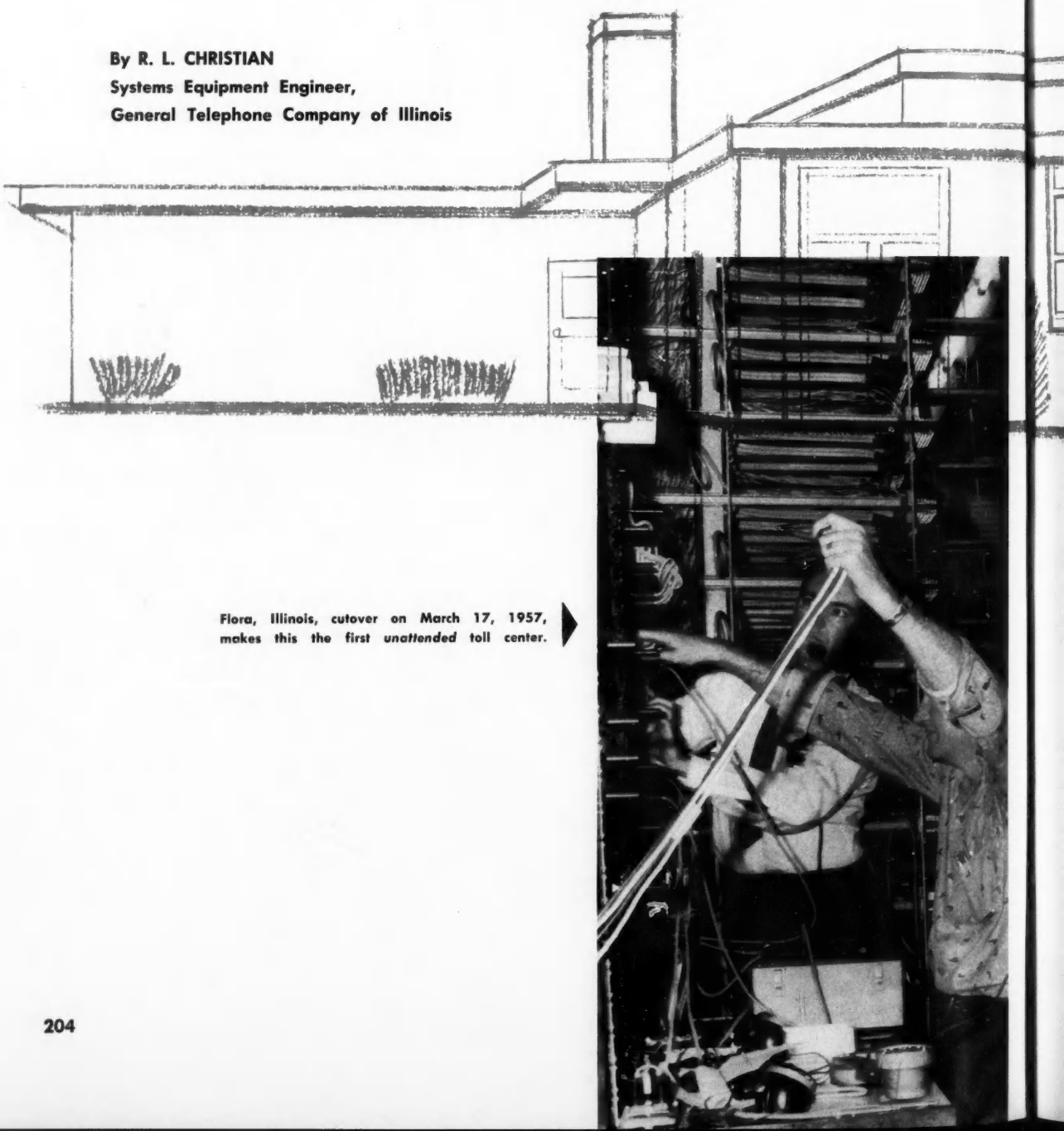
The foregoing outline of the Type "BD" SATT system covers the basic exchange equipment, features and operating facilities of this system as they have been developed and placed in actual service.

From actual operating experience in providing DDD service, it is now evident that the "dual service" facility of the Type "BD" SATT system is and will continue to be a most versatile and economical means of providing DDD service in small and medium-sized telephone networks.

JOHN E. OSTLINE came to the United States in 1905 from Sweden. Being interested in construction, maintenance, and operation of telephone properties he became engaged in this line of work. Later he took up traffic engineering, specializing in call indicator, AB toll, and other facilities relating to multi-office networks. Mr. Ostline joined Automatic Electric Company in 1921, and was sent to England to assist in the conversion of the London telephone system to automatic operation using the Strowger "Director". Mr. Ostline has made many important contributions to automatic switching, a notable example being the development of automatic toll ticketing. He is a Fellow of the American Institute of Electrical Engineers, and a Chartered Electrical Engineer in England.

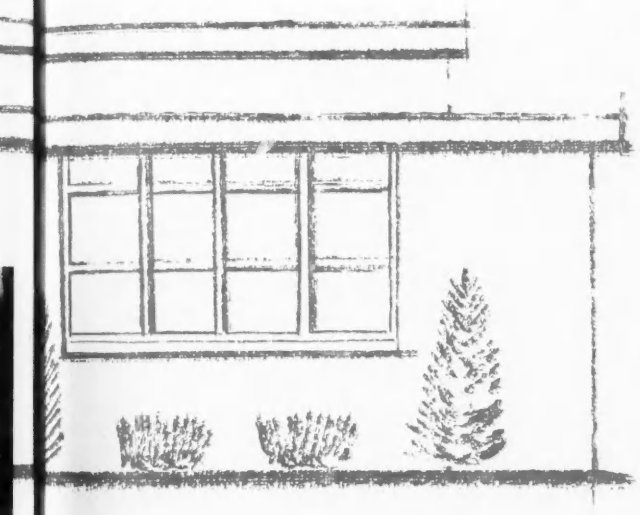
NOVEL USE OF SATT CREATES UNATTENDED TO

By R. L. CHRISTIAN
Systems Equipment Engineer,
General Telephone Company of Illinois



Flora, Illinois, cutover on March 17, 1957, makes this the first *unattended* toll center.

ED OLL CENTER



A new method of operation for Direct Distance Dialing was recently initiated at Flora, Illinois. Under this new system, the checking operator is stationed at Olney, Illinois, twenty-five miles from the Flora exchange. By remote control the Olney operator is connected into the Flora ticketer for requesting the calling station number, just as if she were located at the Flora exchange. In this way, we have been able economically to provide customer toll dialing in this relatively small exchange.

Included in the Flora network in Clay County are some 2,350 dial telephones at Flora, and 500 in Clay City, both exchanges operated by General Telephone Company of Illinois. There are also 960 telephones in Louisville, Xenia and Bible Grove, which are dial tributaries of the Wabash Telephone Cooperative (incidentally, these were converted to dial operation a few days before the Flora cutover).

Background

Previous to the recent dial cutover, Flora was a regular manual toll center (Figure 1, page 208 shows the Flora trunking arrangement prior to conversion.) When it became apparent that the Flora switchboard would have to be retired, several alternative plans were considered for replacing it:

(A) Convert Flora to unattended dial operation, with the toll center at Olney. One real difficulty with this plan was the handling of the tributary traffic which terminates at Flora, and the large trunk group that would be required between Flora and Olney to handle this traffic. This plan was based on the assumption that the tributaries would tandem switch at Flora. However, because the operators at Flora had been ticketing and timing all toll traffic from the tributaries, this traffic would have had to be hauled to Olney for ticketing and timing, and then dialed back over the Flora-Olney trunk group. Dial equipment would also have to be installed on the manual tributary switchboards.

Another disadvantage of this plan was the fact that part of the toll traffic from Flora and its end offices flows west toward Centralia and St. Louis—while the proposed toll center at Olney was located some twenty-five miles *east* of Flora. As a result, handling of this toll traffic in the normal manner at the Olney toll center would involve a substantial backhaul on toll trunk facilities.

(B) Convert Flora to local dial operation and retain it as a toll center until a DDD installation could be made at Centralia, Illinois (Illinois Bell Telephone Company exchange). Take full advantage of operator toll dialing over the trunk groups to Centralia, Fairfield, Olney, and St. Louis, Mo., to affect all operating economies possible.

The major undesirable feature of this plan was that an operating staff would still be required in the new building, resulting in a greatly increased building investment for operating room and restroom space. It would also involve additional investment in manual toll switchboard positions. (This would, however, be offset somewhat by the need for additional positions at Olney if Flora was changed to a tributary of this point.) However, an important and desirable feature of this plan was that no major plant investment would be required for additions or rearrangement of toll circuits.

(C) Convert Flora to unattended dial operation with Centralia, Illinois, serving as the principal toll center for Bell and A. T. & T. business; retain Olney for D. S. A. service and as a partial toll center for certain items of Independent business; reroute the remainder of the traffic via Centralia. However, the difficulty here again was primarily with handling of the tributary traffic, the provision of adequate trunk facilities to Centralia and Olney, and the loss of some toll revenue.

(D) Install customer toll dialing (SATT) equipment at Flora initially; retain present toll and tributary circuits. This would permit direct outgoing toll service from Flora and tributary offices for all dialable traffic and permit inward dialing of all toll calls. These features would substantially reduce the amount of traffic handled by the toll center operators, and would favor use of Olney as the regular toll center because the amount of traffic requiring a backhaul would be sharply reduced.

After many conferences on the above plans, and considering the economies that would be achieved, it was decided that Plan D came the closest to solving the problem at Flora. Two problems were still outstanding, however, which had to be resolved, economy-wise, before this plan could be accepted. The first was how to handle the identification of the calling number on customer-dialed calls. The initial volume of dialable traffic was small; hence fully automatic number identification (Type B SATT) was not economically justified. Type D service (operator identification of the calling number) appeared to be a more economical answer, but the primary considerations of Plans B and C was the elimination of operators at Flora.

This problem was presented to General Telephone Laboratories with recommendations that a remote control unit be designed which would allow the SATT answering operator to be located at Olney, where a toll switchboard was maintained on a twenty-four-hour basis. This resulted in the novel scheme of a Type D SATT installation with operator control from a remote location.

The second item requiring further attention was the desire to reduce backhaul of traffic to a minimum. This was accomplished by providing dialback service on the operator trunks to Olney. Dialback service is not novel, but it was expanded by General Telephone Laboratories for this installation, to meet all essential signaling and transmission features of nationwide toll dialing.

Under normal recentering, for example, the Bell System toll outlets out of Flora would have been discontinued and the traffic routed via the toll center. The problem of backhauling through the twenty-five-mile Olney-Flora section was presented to the Illinois Bell Telephone Company, along with the request that direct circuit groups be retained at Flora. The request was approved, and with the development of the remote control and dialback trunks by General Telephone Laboratories, the path was cleared for the implementation of a modified Plan D, calling for a Type "BD" SATT system to be installed at Flora, with Olney serving as the single, attended toll center.

Equipment Aspects

The dial equipment at Flora is Automatic Electric Company step-by-step equipment providing 1200 urban and 60 rural lines, using a 2-5 numbering system with a neutral prefix exchange designation—NOrmandy 2 (that is, 662).

Toll equipment for outgoing calls consists of a dual train, equipped so subscribers at Flora and its dial tributaries can establish their own DDD calls by access from the ninth level of the local first selectors, or from the assigned levels of the level-hunting type incoming tributary SATT selectors (both SATT access codes are "90"). Nondialable station-to-station traffic, person-to-person calls or other operator assistance calls are routed to the Olney CLR operator by dialing "0" at either Flora or the tributaries.

Changed toll transmission requirements necessitated readjustment of toll equipment.

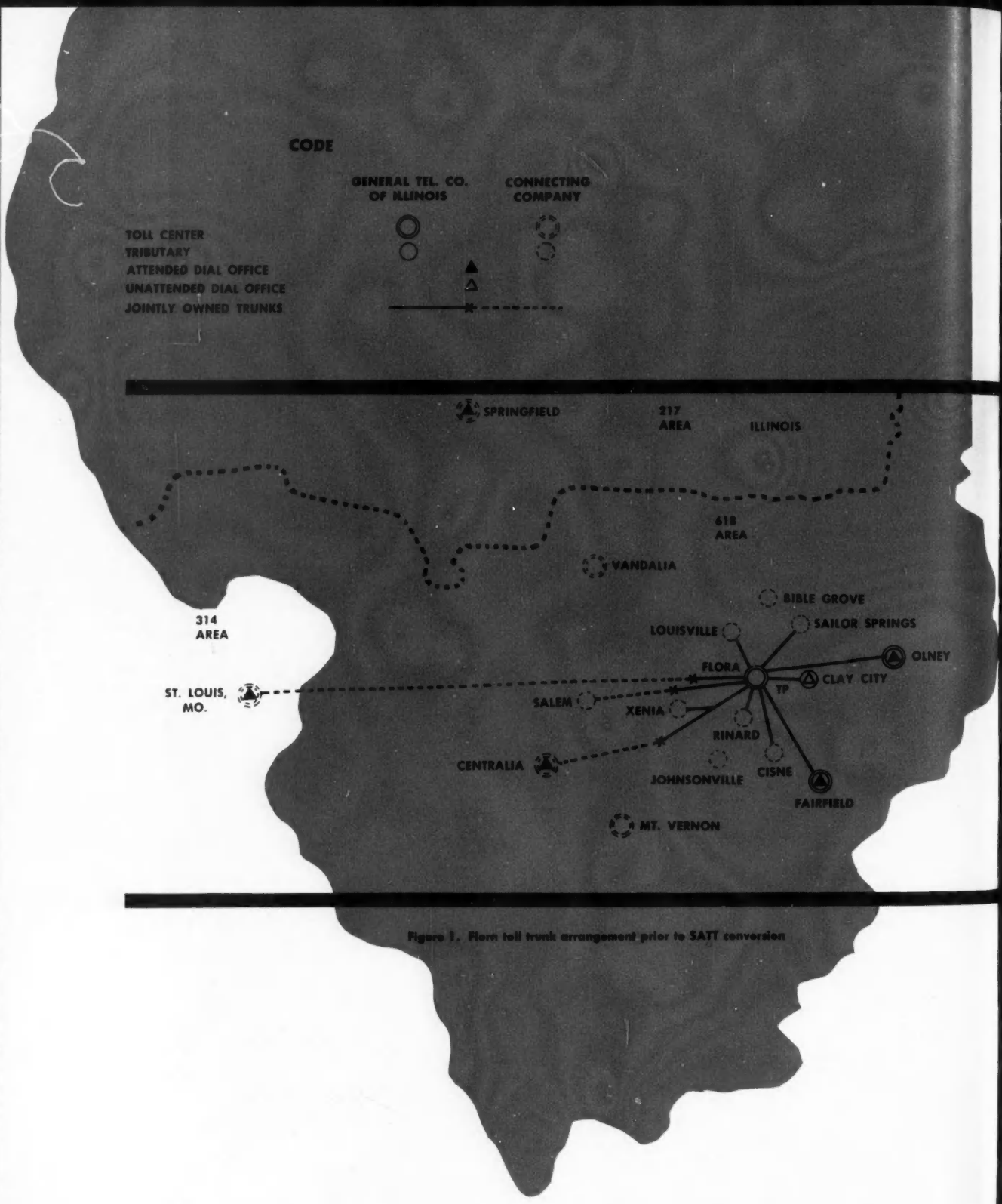


Figure 1. Florn toll trunk arrangement prior to SATT conversion

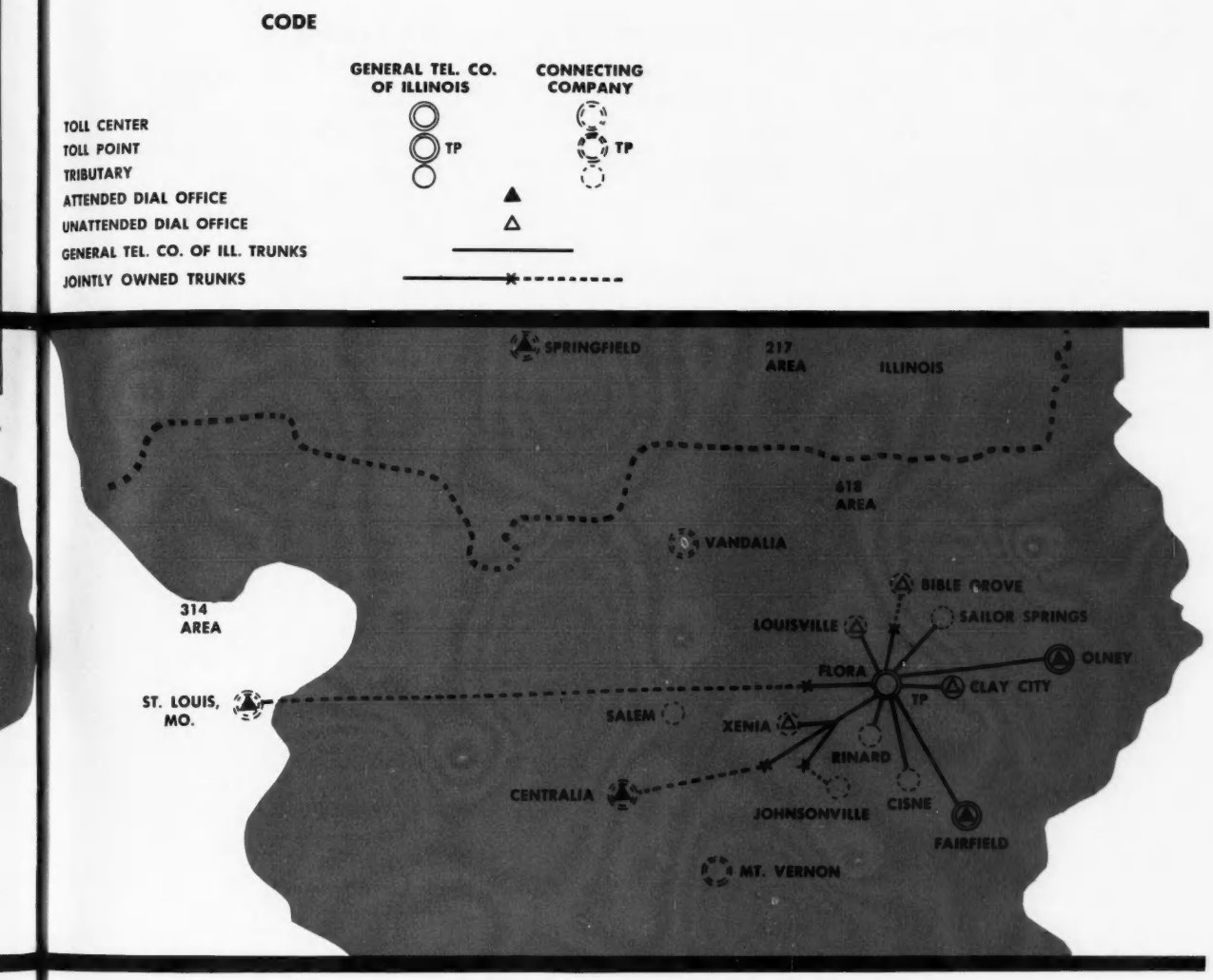


Figure 2. Flora toll trunk arrangement following SATT conversion

The dial tributary offices are equipped with dual function repeaters; these units send a single pulse when accessed from the zero level (see Figure 3). When the ticketer access (90) is dialed, the repeater does not send a pulse, but causes the call to access the ticketers at Flora.

The manual tributaries about Flora were equipped with dials and the necessary two-way trunk equipment for operation with the Flora equipment. Manual tributaries access the toll train equipment by means of repeaters and incoming selectors, which are blocked from the SATT system, but provide access for the tributary operators to the Olney operator and all other tributary offices in the Flora area by dialing. Calls from the manual tributary offices to any office in the Flora area are timed and ticketed by the originating tributary operator (a change from previous practice). This, too, helped in reducing traffic handled by Olney operators (see Figure 3, pages 212-213).

Figure 1 shows the Flora arrangement before conversion and Figure 2 shows the toll trunk arrangement following conversion. The chart on the next page indicates pre-conversion and post-con-

Exchanges and Trunk Arrangements in the Flora SATT Network

Exchange	Type of Office	Office Designation	Type of Trunk	Prior To Conversion	Following Conversion	Method Wire	Method Derived	Carrier
Olney	T.C.		Toll	6 Ringdown	15 Dial-Dial	—	15	Note 1
Olney	T.C.		Toll	—	(Dialback)	—	—	Note 2
Olney	T.C.		SATT Control	—	12 Dial-Dial	2	10	
Fairfield	Dial		Toll	3 Ringdown	2 Control	2	—	
Centralia	Dial		*Toll	7 Ringdown	5 Dial-Dial	3	2	
St. Louis	Reg. Center		*Toll	7 Ringdown	8 Dial-Dial	8	—	Note 3
St. Louis	Reg. Center		*Toll (One Way)	—	7 Dial-Dial	3	4	Note 4
Cisne	Mag.	TIlden 4 (844)	Toll	3 Ringdown	4 Cust. Dial	—	4	
Clay City	Dial	ORchard 3 (673)	Toll	7 Dial-Manual	5 Dial-Manual	3	2	
Johnsonville	Mag.	ORleans 6 (676)	*Toll	—	9 Dial-Dial	9	(Cable)	
Bible Grove	Dial	ORange 4 (674)	*Toll	—	2 Dial-Manual	—	2	
Louisville	Dial	OVerbrook 6 (686)	Toll	3 Ringdown	2 Dial-Dial	2	—	
Rinard	Mag.	NOrth 5 (665)	Toll	2 Ringdown	5 Dial-Dial	4	1	
Sailor Springs	Mag.	MUseum 7 (687)	Toll	1 Ringdown	3 Dial-Manual	1	2	(Combinatio
Xenia	Dial	MUrray 9 (689)	Toll	3 Ringdown	2 Dial-Manual	2	2	
Salem	C.B.	ORiole 8 (678)	*Toll	3 Ringdown	4 Dial-Dial	3	1	

**Denotes jointly owned circuits. All others are wholly owned by General Telephone Company of Illinois.*

Note 1: Used for calls to and from T.C. operator at Olney.

Note 2: Used for inward intertoll calls and outward customer-dialed toll calls.

Note 3: Used for inward intertoll traffic and for outward traffic under control of T.C. operator (dialback calls).

Note 4: Used for customer-dialed toll calls to St. Louis and nationwide traffic.

version trunk group quantities and other miscellaneous information. Flora is now officially classified as a Class 4P toll point (a toll switching point without operators) by AT&T standards.

Toll Circuit Arrangements

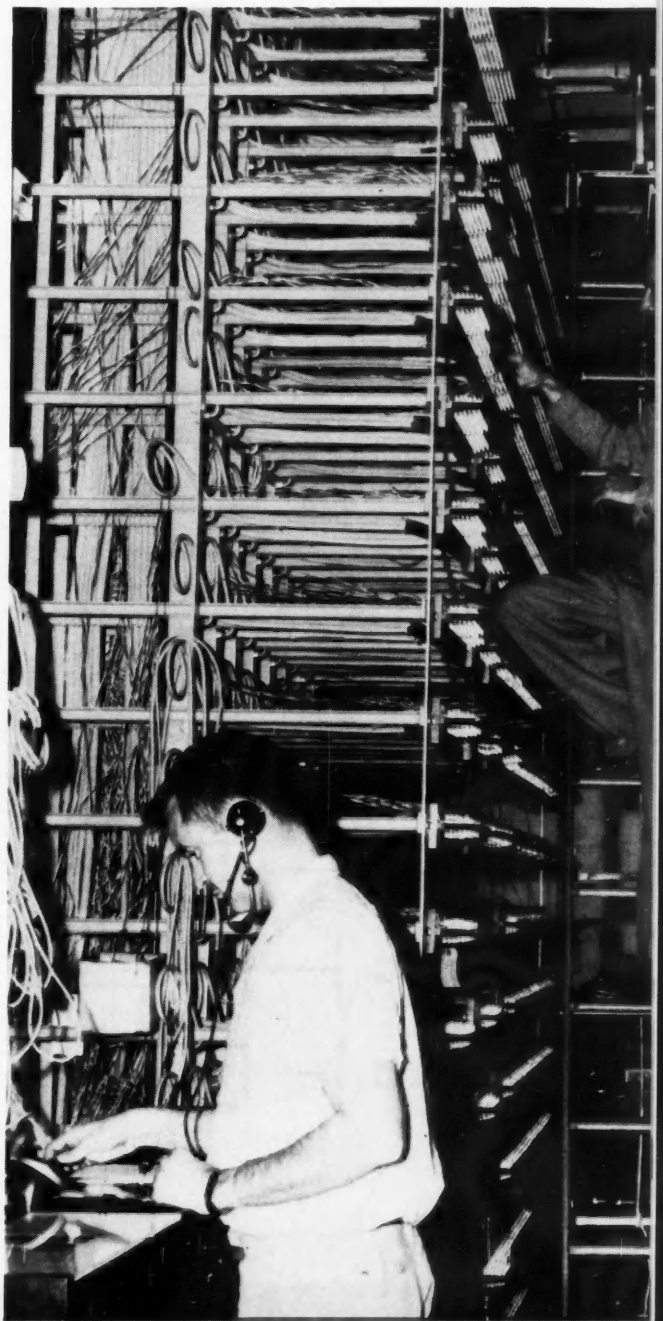
Circuit rearrangement, addition and retransposition work was necessary on many toll leads, to meet toll circuit requirements resulting from the creation of an unattended toll center at Flora. Lenkurt Electric Company Type 45CB and Type 33A carrier systems were used to increase the trunk groups as required for customer toll dialing operation. The jointly owned trunk groups to St. Louis and Centralia are built up with a variety of facilities—Lenkurt 45CB carrier equipment, Western Electric Company V-3 repeaters and Lenkurt four-wire termination sets. Single-frequency dialing and signaling is utilized on these circuits, because of the overall economy and dependability realized from this type of signaling with the facilities used.

Carrier dialing and signaling (E and M), or polar duplex composite dialing and signaling was used for all other trunk groups except the Clay City tributary trunk group, which incorporated simplex dialing and battery-and-ground signaling over a short-haul trunk cable.

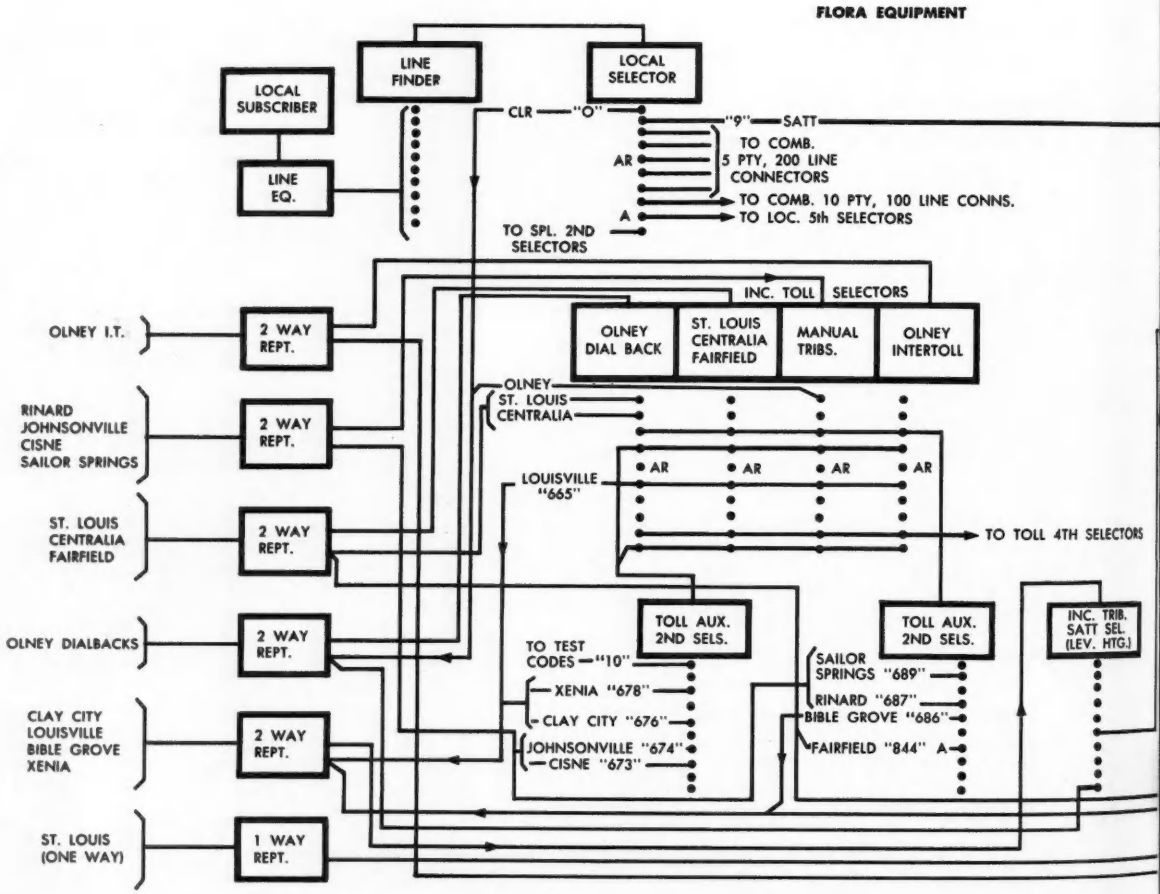
Toll transmission was established to Flora on a

via net loss +2db basis, with service to the tributaries of Flora on a via net loss +4db basis. Carrier and repeater gains were set to provide the required transmission for the above objectives.

The maintenance of these desired transmission objectives at Flora under conditions where the dialback type of operation was used presented a special problem. This was solved by the design of the special dialback trunk which permits removal of the trunk bridge in the transmission path at Flora during the conversation period, while supervision paths to the Olney operator are retained intact. Restoration of the transmission bridge is under full control of the toll operator.



Testboard and main distributing frame in Flora office.


FLORA EQUIPMENT
LOCAL SUBSCRIBER
LINE EQ.
LINE FINDER
LOCAL SELECTOR
CLR
"O"
"9"
SATT
AR
TO COMB. 5 PTY, 200 LINE CONNECTORS
TO COMB. 10 PTY, 100 LINE CONNS.
A
TO LOC. 5th SELECTORS
TO SPL. 2ND SELECTORS
INC. TOLL SELECTORS
OLNEY DIAL BACK
ST. LOUIS CENTRALIA FAIRFIELD
MANUAL TRIBS.
OLNEY INTERTOLL
OLNEY I.T.
2 WAY REPT.
RINARD JOHNSONVILLE CISNE SAILOR SPRINGS
ST. LOUIS CENTRALIA FAIRFIELD
OLNEY DIALBACKS
CLAY CITY LOUISVILLE BIBLE GROVE XENIA
ST. LOUIS (ONE WAY)
1 WAY REPT.
OLNEY
ST. LOUIS
CENTRALIA
LOUISVILLE "665"
TO TOLL 4TH SELECTORS
TOLL AUX. 2ND SELS.
INC. TRIB. SATT SEL. (LEV. HTG.)
TO TEST CODES
"10"
XENIA "678"
CLAY CITY "676"
JOHNSONVILLE "674"
CISNE "673"
SAILOR SPRINGS "689"
RINARD "687"
BIBLE GROVE "686"
FAIRFIELD "844" A

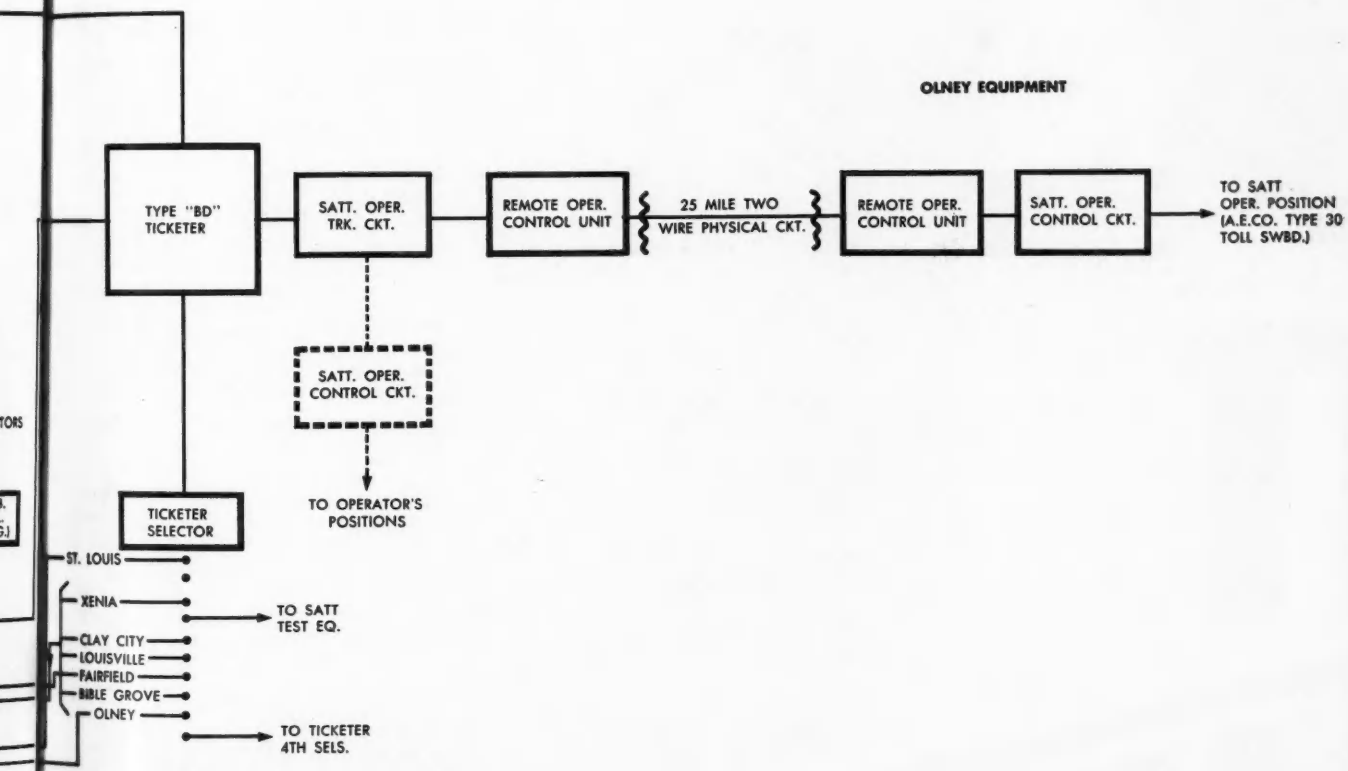


Figure 3. Simplified trunking schematic of Flora SATT network.

Tape perforators and associated equipment in Flora office.

Olney Equipment

At Olney, an intertoll train was added at the time of the Flora cutover to more efficiently handle the existing and the increased toll traffic load. In addition, the existing Automatic Electric Company Type 30 toll switchboard was modified for SATT answering operator service. To facilitate this, it was necessary to install keysets on the first two (inward) toll positions along with the associated apparatus required for SATT answering service. The operators working these two positions now serve both as inward operators for Olney and as SATT answering operators for Flora. The actual SATT work load at this time is only a fraction of an operator's load; hence, it can be handled by the inward operators as part of their regular work.

The other traffic originated by Flora and tributaries (CLR and DSA) could be accommodated on the existing Olney tollboard, since a two-position excess existed prior to the Flora conversion. Introduction of intertoll dialing provided additional relief on the Olney toll-board.

Olney is presently rated a regular toll center (Class 4C toll office). The routing of toll traffic from and to Flora, a Class 4P toll point, via another Class 4 toll office does not, however, conform to the ultimate objectives of the nationwide transmission plan. This matter is receiving continued attention; it is expected that provision will be made eventually to improve the transmission aspects of this special situation.

Special Service Facilities

An Automatic Electric Type MCF Recorder-Announcer is provided at Flora as a three-channel intercept announcer for incorrect area codes or central office prefixes, vacant levels and unassigned or dead numbers. Operator intercept service for changed numbers is provided by the Olney operator over the regular CLR trunk group. An auxiliary SATT answering turret is provided in the dial office at Flora, but not normally used. It can serve in an emergency, if the two SATT control trunks to Olney should be out of service due to outside plant trouble.

SATT Traffic

The current SATT traffic is slightly less than was anticipated; however, if the present rate of increase in SATT calls continues, Flora will soon surpass all expectations. In May, an average of 300 messages per day were ticketed from Flora and its dial tributaries (about 60% of this traffic represents calls entirely within the Flora network). This means that approximately 40% of the total toll messages are being placed over the SATT equipment. Almost daily, new dialable points are added to the nationwide customer toll dialing network. Furthermore, for various reasons, a number of nearby exchanges are not dialable at present; when these restrictions are lifted, considerably more traffic will become dialable. This will reduce the work to be done by the regular toll operators at Olney.

Billing Procedure

Perforated message tapes from the SATT equipment at Flora are sent to the Springfield General Office, where toll bills are then prepared. This is done by feeding the tape into an IBM Machine and obtaining IBM cards, which are then processed

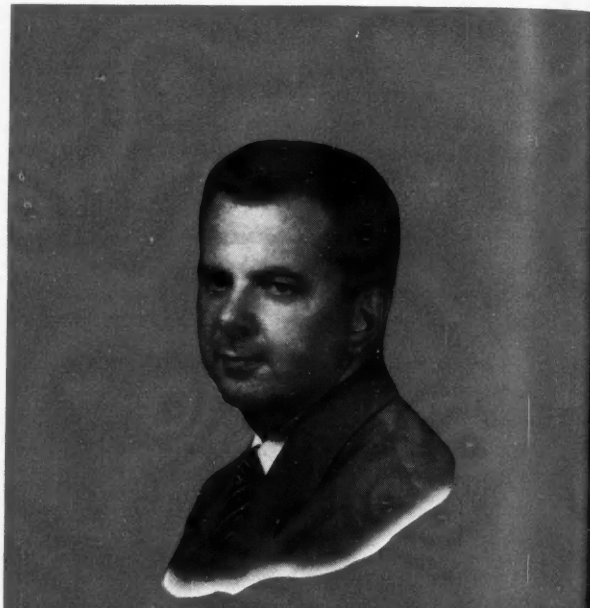
by IBM Computers. The end-product is an itemized statement of toll service sent to each customer.

In time, as more General Telephone Company of Illinois exchanges are converted to SATT operation, the IBM process will become increasingly efficient. However, current cost data figures kept by the IBM section indicate the messages are even now being processed at two cents per message. After two months of DDD service, it was found that only 2.2 percent of the messages processed by the IBM section resulted in IBM cards which were unbillable because of such things as wrong calling number, calling and called number alike, calling and called prefix alike and number different, calling prefix wrong, or tape improperly punched. This figure is not deemed excessive, and will decrease as both customers and operators gain more experience with DDD.

Conclusion

The Type "BD" SATT system, initially operating on a D basis only, was selected as the most appropriate system for Flora because of its economy and the present trend of major operating companies to consider "manual" (operator) identification as normal procedure in customer toll dialing; no longer is it regarded as "partial automatic", or as a temporary expedient. On the other hand, if it should ever become desirable, for any reason, to provide automatic identification of the calling station, the "BD" system permits this to be done without changing the ticketers. The combination of services provided in this network has successfully accomplished the creation of an unattended toll center (or toll point), without requiring major regrouping of existing toll circuits. Thus it has provided for direct customer toll dialing over the shortest direct route—thus speeding up the completion of toll calls—which in turn, increases the efficiency of toll operation, and the net return on investment in toll facilities. This operation has been instrumental also in reducing operator expense, getting more automation into the billing process and consequently lowering billing costs.

Based on the satisfactory operation of the Flora network, the General Telephone Company of Illinois has already planned installation of a number of other similar systems, one of which is currently being installed.



RICHARD L. CHRISTIAN began his telephone work in 1948 with General Telephone Company of Illinois as Assistant Equipment Engineer in the Plant Department. In 1951 he took a leave of absence to serve with the U. S. Navy; he returned to General Telephone Company in 1953. At the present time he is serving as Systems Equipment Engineer in charge of the Central Office equipment section of the Engineering Department.

Mr. Christian is a graduate of Iowa State College, with a degree of B.S. in Electrical Engineering. He is member of Eta Kappa Nu, the Electrical Engineering honorary fraternity and Pi Mu Epsilon.

NOTES

NOTES